

LANDCARE AT THE TOP OF THE WORLD – CONSERVATION STRATEGIES IN ICELAND

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Abstract

Experiences from almost 100 years of combating land degradation and desertification in Iceland are used to illustrate changes in conservation strategies, and some of the key elements of successful soil conservation and ecosystem restoration work. Among the main tools in combating the problems of land degradation and desertification and restoring land health are: attaining sustainable land use; increasing knowledge of problems and solutions; educating and advising; enhancing land user responsibility; improving legislation; and encouraging wide ranging participation. Carbon sequestration as a tool in meeting Iceland's obligations under the Kyoto Protocol has also become an incentive for restoring land health.

Desertification in a Humid Environment

The nakedness of many parts of Iceland may be regarded as one of its most striking features. Most of this reflects ecosystem damage, and a large proportion of the deserts may have been created during the last millennium by the interaction between unsustainable land use and natural forces in a sensitive environment. Iceland is located just below the Arctic Circle, and located on the Mid-Atlantic ridge; continentally, one side belongs to Europe, the other to North America. It has a land area of 103 000 km² and a human population of 290 000. The climate is cold temperate to alpine, with monthly mean temperatures in the south ranging from around -1° to +11°C. Rain is ample for vegetation growth in most parts of the country.

Settlement and initiation of land degradation

Iceland was settled by Scandinavian Vikings around AD 874. They came to a vacant country, although some Irish monks may have dwelt there. The Saga period, the first few centuries of settlement, was a time of prosperity. The foundation for the initial wealth of the Icelanders was the fertility of the land. Up to two-thirds of the country may have been vegetated, and at least 25% of the area was covered with woodlands, mostly birch (*Betula pubescens*) (Aradottir and Arnalds, 2001).

There are several indications that land decline was greatly accelerated by the settlement. The woodlands were cut for fuel and timber, or burned to provide space for agriculture and grazing. Regeneration was hampered by heavy grazing, and the woodlands receded. With the reduction in woodland cover, sensitive soils lost their shelter. Unsustainable land use, interacting with frequent volcanic eruptions and climatic fluctuations, marked the beginning of dramatic ecosystem destruction, a process that has continued to the present (Arnalds, 2004).

Effects of 1100 years of land use

For the first 1000 years of inhabitation, Iceland was almost entirely a country of self-subsistence, to a large extent founded on hay- and grazing-based livestock production in a harsh environment. Woods and shrubs were extensively cut for fuel. The ecosystems were vulnerable to land use pressures following settlement, interacting with natural forces. Ecological capacity was exceeded, and catastrophic soil erosion and desertification has devastated large parts of the country. About half of the vegetative cover may have been lost, implying that about 3 million hectares have become eroded. Only 1% of the area of Iceland is covered by woodlands, compared with at least 25% originally. Much of remaining vegetation is severely degraded. Biological diversity has also been greatly reduced, land fertility diminished, hydrology altered and microclimates changed.

A national survey of the nature and extent of soil erosion was completed in 1997, revealing that serious soil erosion characterizes about 40% of Iceland (Arnalds *et al.*, 2001). Immense amounts of soil and organic carbon – the foundation of land fertility – have been lost.

Lessons From the Past

The severity of land degradation in Iceland prompted in 1907 the establishment of Northern Europe's only designated, and possibly the world's oldest, Soil Conservation Service (SCS) (Runólfsson, 1978 and 1987). The Forestry Service, originally established by the same law as the SCS, had the role of combating the destruction of woodlands in Iceland and overseeing the task of reforestation.

In the almost 100 years of soil conservation in Iceland, much has been achieved in the battle against soil erosion, despite limited resources for most of this time. The first sixty years were almost entirely devoted to the urgent task of halting sand dune advance and other forms of catastrophic soil erosion in pastures and rangelands that left barren deserts behind and threatened the existence of several communities. This work was mainly conducted by fencing and seeding the native sand stabilizer, *Leymus arenarius* (Runólfsson, 1987). With more availability of fertilizers and better equipment around 1950, revegetation of some of the vast areas of denuded land slowly began. Emphasis on grazing management and other preventive measures emerged still later.

The fight against the rapidly encroaching sand dunes was highly successful. However, on a national scale, not enough has been achieved in the battle against desertification and in restoration of lost resources. The conservation work has been limited only to selected parts of the country, the areas with the most severe problems. Only a fraction of the affected areas have been treated, and precious soil and vegetation is still being lost through erosion. It is not only in Iceland that soil conservation programmes of the past have not been effective enough in attaining their overall goals. A part of the explanation may be universal in nature, as the same strategy and organizational mistakes have been seen in many other, widely differing, countries, e.g. the top-down approach, lack of local involvement and “curing symptoms but not the causes” (Douglas, 1996; Sanders, 2000; Hannam, 2000).

In general terms, lack of incentives for land user participation and more sustainable land use characterized the first 80 years of SCS activities. Project planning and implementation was commonly undertaken by SCS staff members, using agency machinery, and there was very limited local involvement. Land users were not held responsible for the effects their actions had on the land. Over time, this led to a conceptual problem of “ownership” and a low level of conservation awareness and ethics. As a consequence, soil erosion came to be regarded as the responsibility of government, but not the responsibility of the land users or of others living in the affected areas.

Early work focused only on halting localized erosion. In most cases, only the symptoms of degradation were dealt with, not the actual causes, such as improper and gradually intensifying use of sensitive soils. Off-site effects were generally neglected, and there were few incentives to protect land on a wider scale. This aggravated the “problem of problem ownership” syndrome, and, until recently, there were many blocks to the development of conservation awareness. Since 1990, there has been an increasingly participatory approach to soil conservation, which has markedly increased the adoption and success of conservation projects (Arnalds, 1999). Furthermore, this period has seen an increasing shift away from localized single-issue soil conservation, towards ecosystem management for multiple uses, with more holistic and integrated approaches for land husbandry.

How to Care for the Land?

It has become increasingly clear that a comprehensive framework is required in order to prevent further damage to Iceland’s ecosystems and to restore lost resources. Such a framework must be based on clear, long-term goals and a broad range of views; harmonizing all laws that can affect land use and condition; integrating a wide range of supporting factors such as planning, research, extension and education; and searching for incentives that also stimulate knowledge, awareness and conservation ethics. International conventions and agreements can provide important guidelines. In 2002, the Parliament of Iceland decided on a comprehensive programme that gives SCS an operational framework for the period 2003–2014. The main goals are mitigation of land degradation and desertification, revegetation of eroded land, and attaining sustainable land use. The main tools for its achievement are described, and financing improved substantially, mainly for halting desertification, extending farmer involvement in healing the land, and a new land care incentives programme.

Sustainable land use

Icelandic experience illustrates clearly that ecological sustainability of grazing and other land uses is a large determinant of land health. Most of the island is accessible for grazing, but the ecological conditions over large areas are poor, and there is an urgent need to minimize erosion and enhance vegetation succession on degraded land. In areas of severe land generation and desertification, grazing can have a dramatic effect. In other degraded areas, grazing above certain limits, or even any livestock grazing, can significantly slow vegetation recovery. Sustainable land use is therefore fundamental to conservation of healthy ecosystems, prevention of further desertification, and recovery of degraded land. In many areas, major management changes are needed, including relieving the most degraded rangelands from grazing.

Sheep production in Iceland is costly, mainly as a result of a long indoor feeding period in winter, and has been receiving a high level of governmental support, with more than half of farmers' income being subsidized. To meet public concerns and give the land users a larger conservation role, the current contract between the sheep producers and government has a cross-compliance clause. Starting in 2003/2004, farmers must verify the ecological sustainability of their operation to the SCS in order to obtain a full subsidy (Arnalds and Barkarson, 2003). Farmers not meeting standards must submit a conservation and land improvement plan for SCS approval. This represents a major step towards increased ecological sustainability.

Horse grazing is also an important, but more localized, determinant of land health. In this sector, a voluntary "bottom up" quality control of sustainability is emerging. Crop production has been limited in Iceland, but with new strains of barley and a more favourable climate in recent years, crop acreages are rapidly increasing, and a new soil conservation concern is emerging.

Involving land users and the public

Since 1990, there has been an increasingly participatory approach to soil conservation in Iceland, which has markedly increased the adoption and success of conservation projects (Arnalds, 1999). The *Farmers heal the land* Project includes a 'cost share' partnership with farmers, with conservation work jointly funded by government and farmers. With machinery, work and a small part of the cost of materials, the farmer's share may average around 50% of project cost. This 'bottom up' approach encourages involvement and individual ownership of conservation projects. The programme has been important in building mutual trust between farmers and conservation authorities, which is a foundation for resolving many other issues. Participants have also been active in developing new methodologies, in cooperation with the soil conservationists, greatly advancing the knowledge base for local soil conservation.

The SCS also emphasised working with rural and urban authorities concerning grazing management and revegetation issues. A wide range of clubs and associations, and individual volunteers, have become active in various elements of the conservation work. Working with such groups can be important in bridging the divide between rural and urban communities. The rapidly increasing prominence of forestry in Iceland, which has a large role in conservation and land improvement, also has a strong farmer and public participation focus.

Good farm and land use planning is one of the main keys to long-term sustainability. An evolving cooperative programme of such planning, *Better farms*, combines the forces of soil conservation, forestry, extension and nature conservation in aiding land users in producing their own property plans. This is a very promising programme, with the aim not only to make farmers the active partners in the planning process, but also to improve coordination between the various institutions and organizations that work with farmers. In this participatory approach to farm planning, the participants are provided with good quality aerial photographs and taught the elements of reading the land, information seeking and making their own plans.

Skills and conservation ethics

Knowledge is a primary fundamental when building up attitudes, awareness, skills and conservation ethics, which in turn may govern long-term success in protecting and improving natural resources. Research, education and knowledge transfer are therefore among the key elements of the Icelandic 2003–2014 soil conservation programme. SCS operates research and land information departments that work closely with other related agencies. The institute also works with schools, the public and other sectors on education related to soil conservation issues. There is also good cooperation with the agriculture extension service. Among future objectives is to ensure that all government-funded services to agriculture incorporate due respect for the goal of sustainability.

Financing

Financing the urgent task of the healing land in Iceland is a major burden for a nation of only 290000 people. The SCS 2004 budget is US\$ 6 millions, or about US\$ 21 per capita. This is for all activities. In addition, farmers, volunteers and clubs, district authorities, and a number of other interest groups, provide – in cash or kind – significant contributions towards the healing of Iceland. One of the larger private financers of conservation programs is the Retailer Association, with funds from revenue created by charging for plastic grocery bags in stores.

Iceland and Climate Change

The global task of preventing human-induced climate change has brought a new dimension to soil conservation and forestry in Iceland, because reducing emissions, preventing degradation of soil and vegetation, and carbon sequestration are all important tools to meet the goals of conserving climate. With regard to land fertility, CO₂ may be considered a misplaced resource that vegetation can convert back to organic matter, to be stored in biota and soil.

Iceland is blessed with plentiful hydropower and geothermal power, and the transformation to sustainable energy took place before 1990, the baseline year of the Kyoto Protocol. Left with limited options for reducing greenhouse gas emissions, and encouraged by the success of mitigation and restoration work for 90 years, the Icelandic government decided to use carbon sequestration to meet emission targets for year 2000, and established a special action programme for 1997–2000. This led to a 30% fund increase for halting soil erosion, revegetation and reforestation (Arnalds 2004). The carbon sequestration is regarded as an added benefit, but not a goal in itself. A misplaced resource is being returned to the land for a variety of purposes that benefit both current and future generations.

Conclusion

The experience gained in Iceland is illustrative of failures and successes in conservation work in many parts of the world. With its 1100 years of land degradation and almost 100 years of mitigation work, Iceland provides unusually vivid examples, not only of the long-term consequences of unsustainable land use, but also possible means to halt destructive forces and restore lost resources. The scale of ecosystem disturbance in Iceland, where barren deserts have replaced vegetation and thick soils in many areas, despite ample precipitation, demonstrates the global nature of land degradation and desertification. As in most parts of the world, the management of livestock grazing and other land uses is a key determinant of rangeland health. Clear guidelines for conservation of the natural resources must be set within effective environmental policy and enabling legislation. A major step was taken in the current agreement between the Icelandic government and sheep producers, partly linking subsidies to ecological sustainability of grazing. Increased knowledge and locally-led community involvement, based on a high degree of land literacy, is one of the foundations of the Icelandic 2003–2014 soil conservation programme. Involvement at all stages of the conservation work has proved a very powerful incentive, with wide ranging effects at all levels, from grassroots to Parliament.

References

- Aradottir, A.L. and Arnalds, O. (2001). Ecosystem degradation and restoration of birch woodlands in Iceland. In: F.E. Wielgolaski (ed). *Nordic Mountain Birch Ecosystems*. p293–308. Man and the Biosphere Series, Vol. 27. UNESCO, Paris, and Parthenon Publishing, Carnforth.
- Arnalds, A. (1999). Incentives for soil conservation in Iceland. In: D. Sanders, P.C. Huszar, S. Sombatpanit and T. Enters (eds). *Incentives in Soil Conservation*. p135–150. Science Publishers, Inc., Enfield, New Hampshire, on behalf of WASWC, IBSRAM, SWSCT, and DLD, Bangkok.
- Arnalds, A. (2000). Evolution of rangeland conservation strategies. in: O. Arnalds, and S. Archer (eds). *Rangeland Desertification*. p153–163. Advances in Vegetation Sciences Series. Kluwer, Dordrecht, the Netherlands.
- Arnalds, A. (2004). Desertification in a humid environment – An example from Iceland. *Encyclopedia of Soil Science*. In press.
- Arnalds, A. (2004). Carbon sequestration and the restoration of land health. *Journal of Climate Change*, In press.
- Arnalds, O., Thorarindottir, E.F., Metusalemsson, S.M., Jonsson, A., Gretarsson, E. and Arnason, A. 2001. *Soil Erosion in Iceland*. Soil Conservation Service and Agricultural Research Institute, Reykjavik. 121p.
- Arnalds, O. and Barkarson, B.H. (2003). Soil erosion and land use policy in Iceland in relation to sheep grazing and government subsidies. *Environmental Science and Policy*, 6, 105–113.
- Douglas, M. (1996). A participatory approach to better land husbandry. In: S. Sombatpanit, M.A. Zöbisch, D.W. Sanders and M.G. Cook (eds). *Soil Conservation Extension from Concepts to Adoption*. p107–121. Soil and Water Conservation Society of Thailand.
- Hannam, I.D. 2000. Soil conservation policies in Australia: successes, failures and requirements for ecologically sustainable policy. pp. 493–514, in: E.L. Napier, S.M. Napier and J. Tvrdon (eds). *Soil and Water Conservation Policies and Programs: Successes and Failures*. Boca Raton, Florida: CRC Press.
- Runólfsson, S. (1978). Soil conservation in Iceland. In: M.W. Holdgate and M.J. Woodman (eds). *The Breakdown and Restoration of Ecosystems*. p231–240. Plenum Press, New York.
- Runólfsson, S. (1987). Land reclamation in Iceland. *Arctic and Alpine Research*, 19, 514–517.
- Sanders, D.W. (2000). The implementation of soil conservation programmes. In: O. Arnalds and S. Archer (eds). *Rangeland Desertification*. p143–151. Advances in Vegetation Sciences Series. Kluwer, Dordrecht, the Netherlands.